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TWENTY-SEVEN CASES. BY  
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# THE SENSORY PHENOMENA ASSOCIATED WITH HEMIPLEGIA, AS ILLUSTRATED BY TWENTY- SEVEN CASES.

BY MARION J. ROSS, M.D.

THE frequency with which I have observed, during a two years' residence in a workhouse infirmary, sensory disturbance to be associated with hemiplegia has led me to pay some attention to this subject in the direction of estimating the numerical incidence of such phenomena, their detailed extent, and, if possible, something of their diagnostic importance.

So far as I can learn, little or no attention has been paid by the majority of clinicians to such sensory manifestations as may exist in a case of hemiplegia, possibly because they cannot always be demonstrated, possibly because they have not been considered of sufficient worth.

Most of the motor phenomena in connection with cerebral disease have been thoroughly investigated, and the explanation of the sequence of motor symptoms following any cerebral lesion is now more or less generally accepted. Hitzig and Fritsch in 1870 were the first to prove by experiment that definite movements of the limbs followed electrical stimulation of certain regions of the cortex. Ferrier followed their lead in 1873; and since then he, Charcot, Bastian, Dana, and numerous other observers, have attempted to localize not only the motor but the sensory centres in the cerebrum.

But while the study of motor phenomena is comparatively a simple matter the investigation of sensory lesions is beset with difficulties, and the variable, often contradictory results of the experimentalists leave much still to be done in the field of

sensory cerebral localization. Here experimental evidence is not of the same value as in motor phenomena because of the many inaccuracies which must almost of necessity arise. Gross effects resulting from equally gross lesions may be easily demonstrable to the observer, and it is possible for an animal to show quite obvious signs of local analgesia after the removal of a particular part of the cortex. But in the finer shades of sensibility where the lesion is small and the effect slight, an animal has no power wherewith to express its appreciation or otherwise of a light touch, or to describe any distinction it may draw between the various forms of sensory impressions.

In human beings also, there are many fallacies to be avoided in the testing of sensation, and many difficulties arise which it may appear at first sight almost impossible to surmount. As a *sine qua non* consciousness must be present, and a patient profoundly comatose after a cerebral apoplexy is of no value as a demonstration of anaesthesia. The hemiplegic patient must have retained or recovered at least a moderate degree of intelligence sufficient to enable him to give some verbal expression to any mental response he may make to external stimuli. And even under such favourable conditions the human mental attitude is so much a variable quantity that it entirely precludes the possibility of fixing any definite standard whereby to judge of affections of sensation. Extreme sensitiveness to external impressions, unlimited capacity for all varieties of emotion, neurotic exaggeration—these constitute a mental attitude capable of transforming the slightest tactile impression into the touch of a red-hot iron. On the other hand, dulness or apathy, cerebral exhaustion, capacity for endurance—induced either by want of perceptive power or by a more becoming stoicism—may render a patient apparently irresponsive to even a moderately severe stimulus. Again, a certain amount of power of concentration in the patient is necessary or at least acceptable to the observer, and still more so is his capability of accurate interpretation of various impressions. Then the condition of the periphery itself is of importance as regards its temperature, its hardness or softness, and its general sensitiveness.

Thus it happens that in the testing of sensation one

must necessarily depend so much on the mental acuity of the patient that the difficulty of making trustworthy observations is materially increased.

But in spite of these several drawbacks, it is, I think, possible by minutely examining the same patient under varying conditions, from day to day, to gain a fairly accurate idea of the acuity of his general sensibility, and the extent to which it has been affected by any particular lesion. This conviction led me primarily to approach the subject of sensation from a clinical point of view, and it is the results of such observations I now desire to record.

### CASE I.

M. J., female, aet. 49 years.

*History.*—The patient had a “stroke” twenty years ago, the history of onset being that three days after her first confinement, while scrubbing a floor, she fell down unconscious. On recovering her senses she found her left arm and leg paralysed and numb, her face being drawn to the right, and her speech mumbling. Speech recovered first, and then the leg, and though eventually able to raise her arm, she could not open her hand. Personal and family history unimportant.

*Examination.*—Intelligence average.

*Face.*—Slight arcus senilis present in both eyes. No obvious facial paralysis. Speech unaffected. *Sensation.*—Over the left side of the face there is complete loss of tactile sense, and both thermal and pain sense are markedly diminished.

*Special Senses.*—*Sight.*—No hemianopia. Diminished visual acuity, and contracted field of vision in left eye. *Hearing.*—Watch faintly heard when laid against left ear. Heard 4 inches from right ear. *Taste.*—Totally lost on left side of tongue, the patient being tested with salt, sugar, quinine, and citric acid. *Smell.*—Totally lost in left nostril when tested with cloves, peppermint, lavender, and asafoetida.

*Upper Extremity* lies by the side almost quite flaccid, with the elbow flexed and the hand closed, secondary rigidity being evidenced only by resistance and pain on attempted extension of the elbow and fingers, and by exaggerated radial and deltoid reflexes. There is no power of grasp in the fingers.



*Sensation*.—Tactile sense is quite gone over the fingers and hand. It is present to a slight extent in the arm, but transmission is delayed and localization inaccurate. Thermal sense is absent over the hand, but the cold tube is occasionally recognized in the arm. Pain sense is also absent over the hand, and diminished in acuity in the arm. Muscular sense is gone.

*Trunk*.—Tactile and thermal senses are diminished over the side of the chest and abdomen. Pain sense, though present, is somewhat dulled.

*Lower Extremity*.—Gait is typically "paralytic," the left leg being rigid and spastic, and the toes scraping the ground with each step. Power of both flexion and extension is diminished on the left side. *Reflexes*.—Knee jerks are well marked on both sides, but especially on the left. Plantar reflex is exaggerated, and Babinski's toe phenomenon elicited on that side only.

*Sensation*.—Tactile, thermal, and painful senses are lost over the foot, and impaired over the leg to about the same degree as in the arm. Muscular sense is gone, the patient recognizing no position of the limb or movement of the various toes.

*Diagnosis*.—Left hemiplegia resulting from a lesion involving all the posterior limb of the internal capsule. The history points to embolism of the lenticulo-striate artery, but this would scarcely account for the definite affection of sensation and for the very fair motor recovery. A haemorrhage, therefore, is a most feasible supposition, though the cause for such is obscure.

## CASE II.

T. S., male, aet. 60.

*History*.—About fifteen months ago the patient found on attempting to rise in the morning that he could not move his right leg and arm. He was conscious of a numb sensation all down the right side, but does not think his face was affected, and his speech was all right. He stayed in bed for a week, and has never been able to walk properly since, though he can move his arm fairly well. Personal and family history unimportant.

*Examination*.—Intelligence rather below the average.

*Face.*—No facial paralysis. Commencing cataracts in both eyes. *Sensation* appears perfect to all stimuli.

*Special Senses.*—*Sight* cannot be tested. *Hearing.*—Quite lost on right side. Watch heard when laid against left ear. *Taste.*—Very markedly diminished on right side. *Smell.*—Gone on right side.

*Upper Extremity.*—Is not obviously affected, not being held in any fixed position, and retaining full range of movement. There is no rigidity; but the grasp is inferior to that of the left hand. *Sensation* is diminished slightly to all forms of stimuli, though localization is perfect. The patient occasionally does not know which finger is moved, and sometimes fails to appreciate a very light touch. This is most marked in the hand and forearm. Above that sensation is almost perfect.

*Trunk.*—Sensation somewhat dulled all over right side.

*Lower Extremity.*—The leg lies extended in bed, but can be drawn up and the knee flexed, though the ankle and toes cannot be voluntarily moved. The leg feels rigid, ankle clonus is easily obtained, and the knee jerks are exaggerated. *Sensation.*—Tactile sensation is much diminished, especially over the outer side of the leg and the dorsum of the foot. Thermal sense is also deficient, as regards the cold tube, though the hot is almost invariably recognized. Painful sensation is somewhat dulled, though not to the same extent as the others. Muscular sense is affected in so far as the patient does not know which toe was moved, and cannot differentiate between different weights laid on his foot and leg.

*Diagnosis.*—Left capsular haemorrhage, involving both motor and sensory paths in the capsule; secondary descending degeneration. General sensation is impaired, and special senses are also affected.

### CASE III.

A. C., female, aet. 67.

*History.*—Five years ago the patient had a sudden attack of headache and vomiting, followed by paralysis of the right arm and leg. Her speech was mumbling, but there was no aphasia. She kept her bed for about a week, and then the leg recovered sufficiently to enable her to get about. The



arm gradually developed athetoid movements, which have persisted ever since.

*Examination.*—Intelligence good.

*Face.*—No paralysis. *Sensation* appears perfect.

*Special Senses.*—*Sight.*—No hemianopia or amblyopia, but visual acuity is defective in right eye. *Hearing.*—Diminished in right ear. *Taste.*—Gone on right side. *Smell.*—Gone on right side.

*Upper Extremity* hangs at the side with the third and fourth fingers extended, while the others and the thumb are flexed on the palm. Athetoid movements are marked. Voluntary movement is good. Radial reflex present. *Sensation* appears unaffected, except for a dulness in the appreciation of tactile impressions.

*Trunk.*—Sensation slightly improved.

*Lower Extremity* seems to have recovered very completely, and there is very little evidence of the paralytic gait. Knee jerk is well marked, and Babinski's toe phenomenon is present. *Sensation* appears very little affected.

*Diagnosis.*—Cerebral haemorrhage involving incompletely the motor and sensory part of internal capsule and contiguous optic thalamus. Here the interesting point is the involvement of the special senses to so marked a degree, while general sensation is practically unaffected.

#### CASE IV.

A. T., female, aet. 68.

*History.*—About fifteen months ago the patient became troubled with numbness of the right arm and leg, and a feeling of coldness down the right side. This lasted about six weeks, and then one evening, on trying to rise from her chair, she found she was unable to do so, and had to remain all night where she was, as she could not move her right side. She was never unconscious, but was troubled with forgetfulness of the names of things. She has never recovered the use of her limbs to any extent. *Previous History.*—About twelve years ago she had evidently an attack of acute nephritis, coming on with sickness, diminished micturition, and swelling of the face

and legs. Urine contains moderate amount of albumen. *Family History*.—Grandfather and grandmother both died of apoplexy.

*Examination*.—Intelligence very good.

*Face*.—No obvious facial paralysis. *Sensation* is defective all over the right side.

*Special Senses*.—*Sight*.—Amblyopia distinctly present in the right eye, evidenced by diminished visual acuity, contracted field of vision, and altered perception of colour (bright red is seen as a dirty brownish colour). *Hearing*.—Entirely gone in right ear. Watch heard at 1 inch from left ear. *Taste*.—Absent over right side of tongue. *Smell*.—Absent on right side.

*Upper Extremity* has no voluntary movement except a slight action of the deltoid. Rigidity is very marked and radial reflex is much exaggerated. *Sensation*.—Tactile and thermal senses are lost over hand, and defective over arm. Painful sensation is present, but impaired over arm, and especially over hand. Muscular sense is gone.

*Trunk*.—Sensation is affected to about the same extent as over arm.

*Lower Extremity* is also very rigid. Knee jerks are well marked, and a slight ankle clonus is present on both sides. *Sensation*.—Entirely gone to all stimuli over foot. Much diminished over leg and thigh.

*Diagnosis*.—Capsular haemorrhage involving extensively both motor and sensory paths—probably secondary to high arterial tension and arterial degeneration following nephritis. Both general and special sensations are markedly involved. The absence of aphasia is remarkable.

### CASE V.

G. P., female, aet. 67.

*History*.—In April, 1900, the patient awoke one morning and found she could not move her right arm or leg. Her face and speech were not affected, and she did not lose consciousness. Her leg improved first, and she was able to get about, but could not use her arm much. *Personal and Family History*.—Unimportant.

*Examination.*—Intelligence good.

*Face.*—No facial paralysis. Commencing cataracts in both eyes.

*Special Senses.*—*Sight.*—Not tested. *Hearing.*—Watch heard only when pressed against right ear. Heard 2 inches from left. *Taste.*—Gone on right side. *Smell.*—Gone on right side.

*Upper Extremity* has free voluntary movement. Radial and deltoid reflexes are well marked. *Sensation* is dulled to all stimuli, especially over the hand, but muscular sense appears perfect. Cold is appreciated more than heat.

*Trunk.*—Sensation affected less than over arm.

*Lower Extremity* has also free voluntary movement. Knee jerk is well marked, but there is no ankle clonus. *Sensation* is affected to about the same extent as in arm, and muscular sense is perfect.

*Diagnosis.*—Left capsular haemorrhage involving sensory as well as motor path. The special senses here appear to be impaired to a greater extent than general sensation.

## CASE VI.

W. P., male, aet. 39.

*History.*—About two years ago the patient drank very heavily for several months, and suffered from an attack of delirium tremens. On recovery he found his legs were weak, but he managed to walk with the aid of a stick. Gradually, however, he noticed a loss of power in his left arm and leg, and this was associated with a peculiar numb sensation all down the left side, and with occasional twitching of the fingers and toes, which, on these occasions, became quite blue and cold. He has also suffered occasionally from vertigo and sees objects as if they were swinging in the air. No history of syphilis.

*Examination.*—Patient is a very intelligent man, but is evidently nervous and has an anxious expression.

*Face.*—No paralysis. *Sensation* of touch, pain, and temperature are all markedly impaired, this being not quite limited by the middle line, but extending about half an inch on the right side of the forehead and chin.



*Special Senses.*—*Sight.*—Distinct amblyopia in left eye, consisting of contracted visual field, diminished visual acuity, and altered perception of colour. *Hearing.*—Watch heard only when pressed against left ear. Heard 2 inches from right ear. *Taste.*—Gone on left side of tongue. *Smell.*—Gone on left side.

*Upper Extremity.*—Movements quite free, and no obvious rigidity. Grasp is evidently diminished, and hand and arm are blue and cold. *Sensation.*—Tactile, thermal, and painful sense is diminished all over, but especially on hand. Muscular sense appears perfect.

*Trunk.*—Sensation diminished as on arm, the anaesthesia extending 1 inch beyond the middle line back and front.

*Lower Extremity* appears somewhat stiff, and there is a slight drag in walking, though voluntary movement is good. Knee jerk is well marked, but there is no ankle clonus. *Sensation* diminished to touch, pain, and temperature all over, especially in foot. Muscular sense appears perfect.

*Diagnosis.*—Thrombosis of the right lenticulo-optic artery, possibly specific?

### CASE VII.

J. J., male, aet. 21.

*History.*—When aged 9 years the patient had a “stroke” while working. He suddenly lost consciousness, and on recovering his senses found his left side paralysed. He was removed to St. George’s Hospital (London), and remained there till he had regained the use of his limbs to some extent. Ever since then he has been troubled with “fits,” which came on about once a month, but occur more seldom now.

*Examination.*—Intelligence good. No cardiac murmur. No albuminuria.

*Face.*—External strabismus in right eye, with which the patient can see only very little. *Sensation* generally is diminished over the left side of the face.

*Special Senses.*—*Sight.*—Diminished visual acuity in left eye. *Hearing.*—Watch heard only when pressed against the left ear. Heard 3 inches from right. *Taste* lost on left side. *Smell* lost on left side.

*Upper Extremity.*—Movements free. No rigidity, but the arm is weaker than the right. Tactile, thermal, and painful sensations all obviously diminished. Muscular sense defective when the fingers were moved.

*Trunk.*—Sensation diminished all down left side.

*Lower Extremity* has a slight drag in walking. There is no obvious rigidity. *Sensation* affected much to the same extent as in the arm, but muscular sense appears more impaired in the lower extremity.

*Diagnosis.*—Embolism, with softening, involving distribution of both lenticulo-striate and lenticulo-optic artery (?). The lesion can scarcely have been cortical, on account of extensive involvement of special senses.

### CASE VIII.

M. A., female, aet. 63.

*History.*—About three years ago the patient suddenly fell down while crossing the room, and found she could not use her right side. She gradually became unconscious, and on recovery was evidently aphasic. She has never been able to use her right arm or leg since then, but the speech has improved. *Family History.*—Grandfather, grandmother, and uncle also suffered from hemiplegia.

*Examination.*—Intelligence good.

*Face.*—Slight flattening of right side of face. Sensation is diminished to slight extent over right side.

*Special Senses.*—*Sight.*—Distinct hemianopia in right eye.

*Hearing.*—Gone on right side. Watch heard 3 inches from left ear. *Taste.*—Gone on right side. *Smell.*—Gone on right side.

*Upper Extremity.*—Movements very limited. The arm feels soft, and there is a kind of athetoid movement on voluntary exertion. *Sensation* is only slightly diminished to all forms of stimuli; touch, pain, and temperature being all appreciated, but less distinctly than on the left side. Muscular sense appears perfect.

*Trunk.*—*Sensation* is affected here to the same extent as in arm.

*Lower Extremity* is very rigid, and cannot be flexed either



at the hip or knee. No knee jerk can be elicited (probably on account of extreme rigidity). *Sensation* is affected to the same extent as in arm over the thigh and leg, but is rather more defective over the foot. Muscular sense is difficult to test, but appears unaffected.

*Diagnosis.*—Left capsular hæmorrhage, involving motor and sensory paths, the athetosis indicating involvement of contiguous optic thalamus.

### CASE IX.

D. H., male, æt. 75.

*History.*—Four years ago the patient suddenly observed during dinner that he could not speak, and on attempting to move he found his left side was powerless and numb. He was never unconscious. He partially recovered his speech in several hours, though it was some months before he could speak distinctly. His leg improved quickly, and in a week's time he was able to walk with the help of a stick, and could move his arm to some extent.

*Examination.*—Intelligence fair.

*Face.*—No facial paralysis. Speech unaffected. *Sensation.*—Tactile, thermal, and painful sensations all diminished to about the same extent over the left side.

*Special Senses.*—*Sight.*—Visual acuity is diminished in the left eye. No hemianopia or contracted field of vision. *Hearing* is entirely lost on the left side. A watch placed against the right ear is heard. *Taste.*—Diminished on left side. *Smell.*—Diminished on left side. The patient could smell both lavender and asafoetida, but could not distinguish between them, except when applied to right nostril.

*Upper Extremity.*—The left arm is held flexed at the elbow, with the fingers closed on the palm. A fair amount of movement is present, the patient being able to extend the elbow joint to an obtuse angle. He can also open his fingers, but the movements are very slow. The grasp is good, but the fingers are with difficulty unlocked. The radial reflex is slightly exaggerated. The deltoid is not obtained. *Sensation.*—Tactile, thermal, and painful sensations are all perceived by the

patient, and his power of localization is perfect, but the sensation is much more dull than on the right side, and he cannot tell the difference between the head and the point of a pin. Muscular sense is difficult to test, as the patient can tell by pain when the arm is moved. But he cannot appreciate different weights laid on his left hand and arm.

*Trunk.*—Tactile, thermal, and painful sensations are affected, as in arm, over the left side.

*Lower Extremity.*—*Spasticity* very marked, the patient having some difficulty in moving the leg, and the movements being very slow. He cannot bend the ankle nor flex the toes. *Reflexes.*—Knee jerks very well marked on both sides, but especially on the left. On attempting to lift either leg there is a clonic spasm. Plantar reflex is exaggerated, but Babinski's toe phenomenon cannot be obtained, as the toes are already hyper-extended. *Sensation* appears affected as in arm, but the sensations are more dull, and occasionally the cold tube is not recognized when testing thermal sense. Muscular sense cannot be tested.

*Diagnosis.*—Haemorrhage from the lenticulo-striate branch of the right middle cerebral artery; the haemorrhage in this case has evidently extended into, and partially destroyed, the sensory fibres in the posterior third of the posterior limb of the internal capsule. The special senses are definitely involved.

### CASE X.

M. H., female, aet. 33.

*History.*—Five years ago the patient was confined with her seventh child, and twenty-four hours after delivery she was suddenly seized with a feeling of numbness and great weight in the left leg, which gradually extended to the arm. She became unconscious, and remained so for several hours. On recovery she found she could not move her left side, and her mouth was drawn to the right. Her speech was not much affected. The leg did not recover so well as the arm, which she has been able to move freely for some time, while she can walk only with the help of a stick.

*Examination.*—Intelligence good.

*Face*.—No obvious faeial paralysis. *Sensation*.—Diminished to all forms of stimuli on left side, and transmission is delayed.

*Special Senses*.—*Sight*.—Distinet lateral homonymous hemianopia towards right side. *Hearing* appears equal on both sides. Watch heard at a distanee of 8 inches. *Taste* diminished on left side. *Smell* diminished on left side.

*Upper Extremity*.—Though the arm is held flexed, the patient can move it quite freely, and there does not appear to be any secondary rigidity. Radial and deltoid reflexes are not exaggerated, but the power of grasp in the fingers is less than on the right side. *Sensation*.—Tactile, thermal, and painful sensations are pereceptible all over, but transnission is delayed and the sensation is dulled. Museular sense appears perfect.

*Trunk*.—Sensation is perfectly pereceived, though somewhat dulled.

*Lower Extremity*.—The left leg is rather rigid, and there is markedly diminished power of movement. The knee jerk is well marked, and plantar reflex is exaggerated. Slight ankle clonus. *Sensation* is affected more than in the arm, though the patient can still feel each variety of sensation. Localization of tactile sensibility is oceasionally defective, especially over the foot; and here also heat is oceasionally not reecognized, though cold is always appreeiated. Museular sense appears perfect.

*Diagnosis*.—Haemorrhage from the right lenticulo-striate artery, involving also the posterior third of the internal eapsule; and the greater part of which has been absorbed. Though this lesion was probably haemorrhagic, the cause for such haemorrhage could not be definitely ascertained. Embolism would have suggested itself as an explanation of the occurrenee of hemiplegia in so young a subject, but the eombination of sensory with motor symptoms renders this improbable.

## CASE XI.

J. C., male, aet. 64.

*History*.—About a year ago, while sitting by the fire, the patient suddenly felt a peeuliar sensation in his left leg, and on attempting to rise found he could scarcely move the leg.



He, however, managed, with some assistance, to walk upstairs, dragging his leg after him. His arm and his face, he says, were not affected at this time. He stayed in bed 10 days, and then managed to walk with the help of a stick. In November, 1899, he again suddenly experienced a similar numb sensation in the left leg, but this time it affected the arm also, and his whole side was powerless, though his face was not affected. He was never unconscious. *Family History*.—One brother died of “apoplexy” and one sister of rheumatism.

*Examination*.—Intelligence good.

*Face*.—Slight flattening on left side. Speech unaffected. Sensation unaffected.

*Special Senses*.—*Sight*.—Diminished visual acuity on left side, but no hemianopia or amblyopia. *Hearing*.—A watch is heard ticking at a distance of  $2\frac{1}{2}$  inches on both sides. *Taste* diminished on left side, but present. *Smell* diminished on left side, but present.

*Upper Extremity* can be freely moved, but cannot be fully extended, the patient complaining of pain at the elbow when this is attempted. Radial and deltoid reflex are exaggerated. The grasp is fair, though much inferior to that on the right side. *Sensation*.—Tactile and pain sense are almost perfect over the arm and hand, though somewhat more dull than on right side. Muscular sense appears unaffected. Thermal sense is lost over almost all the arm and hand. Several times the cold tube was recognized when applied to the outer surface of the forearm, but when the hot tube was employed the patient invariably said either that it was cold or that he did not know.

*Trunk*.—Tactile sensation fair all over side, though occasionally not perceived on the left side of the back. Thermal sense diminished, especially with regard to the cold tube. Painful sense not much affected.

*Lower Extremity* can be flexed fully at hip and knee, but not at ankle. The leg appears slightly rigid. Knee jerk is well marked, and plantar reflex is exaggerated, but there is no ankle clonus. *Sensation*.—Tactile sense is present over thigh and leg, though occasionally a touch on the dorsum of the foot was referred to “the shin bone.” Thermal sense is diminished as in arm, the anaesthesia being most marked on

the dorsum of the foot. Painful sensation is only slightly affected, but more dull than on the right side. Muscular sense appears perfect.

*Diagnosis.*—Two separate haemorrhages into right internal capsule at an interval of a few months; the first involving the leg only—that part of motor capsule immediately contiguous to sensory path; the second, more extensive, implicating sensory as well as motor fibres.

### CASE XII.

E. S., female, aet. 56.

*History.*—After being “out of sorts” for about a week, and complaining of sickness and dragging sensation in the head, the patient, suddenly one day three years ago, dropped her fork during dinner, and on trying to pick it up she “fainted.” On recovering consciousness she found she could not use her left arm or leg, that they felt numb, and that she could not articulate very distinctly. Her face was not affected. She never regained sufficient power to walk again, and has never since been able to use her arm. *Personal History.*—History of syphilis—in sore throat, falling out of hair, and intractable ulcer of left leg.

*Examination.*—Intelligence average. Patient is very emotional.

*Face.*—No obvious paralysis. No loss of sensation.

*Special Senses.*—*Sight.*—Diminished visual acuity on the left side, but no hemianopia. *Hearing.*—Equal on both sides, a watch being heard at a distance of 6 inches. *Taste.*—Diminished to some extent on the left side. *Smell.*—Diminished to some extent on the left side.

*Upper Extremity* lies across the chest, pronated, with the fingers bent on the palm. The deltoid action is the only voluntary movement possible. No grasp. Radial and deltoid reflexes are exaggerated. *Sensation.*—Tactile sense is present all over upper arm, though transmission is delayed. It is lost over the forearm and hand, where a light touch is not felt, except once or twice over the extensor surface of the wrist. Thermal sense is diminished all over. Painful sensation is



dulled all over. Muscular sense is also impaired, different movements not being recognized.

*Trunk*.—Sensation to all stimuli slightly impaired.

*Lower Extremity* is very rigid, and the lower third on the external surface is almost covered by an ulcer which has lasted 5 years. There are also several pale round scars on the upper part. Movements are very slow and imperfect. Knee jerk is difficult to obtain, and plantar reflex is present, but not exaggerated. *Sensation* is very difficult to test because of the scarred and ulcerated condition of the leg. But all kinds of sensation appear to be diminished to some extent.

*Diagnosis*.—Right capsular haemorrhage, involving sensory as well as motor path; secondary descending degeneration; cause, specific arteritis (?). Here general sensation appears impaired to a greater extent than the special senses.

### CASE XIII.

J, W., male, aet. 11.

*History*.—About four years ago the patient began to be conscious of a weakness in his right arm. This gradually became worse, and his leg also became weaker. He occasionally suffered from headache and vomiting, and ultimately facial paralysis and nystagmus developed.

*Examination*.—Intelligence average. *Temperature*.—Right axilla, 100° F. Left axilla, 99·6° F.

*Face*.—Obvious facial paralysis on the right side. Left lateral nystagmus is marked. *Sensation* is chiefly diminished to tactile, thermal, and painful stimuli.

*Special Senses*.—*Sight*.—Optic neuritis. No hemianopia. *Hearing*.—Diminished on the right side, where a watch is heard at a distance of 3 inches, while it is audible at 6 inches on the left. *Taste* diminished, but present on right. *Smell* diminished, but present on right.

*Upper Extremity*.—The hand is flexed on the forearm, while the fingers are hyper-extended. Slight athetosis is present. The movements of the arm are free, but the radial and deltoid reflexes are exaggerated, and the grasp is weak. *Sensation*.—Tactile, thermal, and painful sensations are diminished all over

the arm, and localization is defective. Muscular sense is defective.

*Trunk.*—Sensation is affected to rather less a degree than in the arm.

*Lower Extremity.*—Movements are free. Knee jerk exaggerated. Ankle clonus, knee clonus, and Babinski's toe phenomenon present on the right side. *Sensation.*—Tactile and thermal absent over foot, and painful sense is diminished. All senses are present, but impaired over leg and thigh. Muscular sense is diminished.

On March 25th the skull was trephined over the motor area, and a needle inserted in various directions. No surface tumour was detected. On examination on the 28th, sensation in the face and arm was found affected almost to the same extent as before, but was markedly defective in the leg and foot, which area in the motor cortex had been irritated by the needle.

*Post-Mortem.*—A large gliosareoma was found occupying all the left internal capsule, corpus striatum, and optie thalamus. It extended to the middle line, pressing on the anterior corpora quadrigemina and veins of Galen. The ventricles were much dilated.

#### CASE XIV.

R. B., female, aet. 64.

*History.*—On waking one morning twelve years ago the patient found she was unable to use her left side, and on trying to get out of bed she lost consciousness. At first, on recovery, she could not speak, but this improved, though her articulation has since been somewhat defective. *Family History.*—Father died after a "stroke."

*Examination.*—Intelligence fair.

*Face.*—No obvious faeial paralysis. Internal strabismus. *Sensation* is not affected over the faee.

*Special Senses.*—*Sight* cannot be tested, as patient has been blind in the left eye for many years. *Hearing.*—Slightly more diminished on left than on right side. *Taste.*—Diminished on left side. *Smell.*—Diminished on left side.

*Upper Extremity* is held at right angles, with the fingers

flexed on the palm. The arm appears very rigid, and the radial and deltoid reflexes are exaggerated. *Sensation* is diminished over the arm and hand, in all its forms, though the cold tube is sometimes appreciated in the testing of thermal sense.

*Trunk*.—*Sensation* appears almost perfect.

*Lower Extremity*.—Rigidity is well marked. Knee jerks are well marked, and ankle clonus present on both sides, but Babinski's sign is elicited only on left side. *Sensation* is diminished to all stimuli, but only slightly over thigh and leg, and more markedly over the foot.

*Diagnosis*.—Right capsular haemorrhage involving both motor and sensory paths, and affecting motor speech; secondary descending degeneration.

### CASE XV.

S. D., female, aet. 50.

*History*.—On waking one morning two years ago the patient found her left side paralysed, her mouth twisted, and her speech gone. She was not unconscious, and gradually recovered, till she was able to use her limbs fairly well.

*Examination*.—Intelligence fair. Heart sounds pure. No albumen in urine.

*Face*.—Slight flattening on left side. *Sensation* appears perfect all over.

*Special Senses*.—*Sight* is equal and good on both sides.

*Hearing*.—Entirely gone on left side, but apparently unaffected on right. *Taste* diminished on left side. *Smell* diminished on left side.

*Upper Extremity*.—Very good voluntary movement. Radial and deltoid reflexes exaggerated. *Sensation* appears practically unaffected.

*Trunk*.—*Sensation* appears practically unaffected.

*Lower Extremity* is somewhat rigid. Knee jerk exaggerated, and ankle clonus well marked on left side. *Sensation* appears almost perfect.

*Diagnosis*.—Right capsular haemorrhage involving posterior third to slight extent.



Here the special senses are more or less impaired, hearing being lost on the affected side, but normal on the sound side.

### CASE XVI.

A. H., female, aet. 56.

*History*.—About three years ago the patient began to be aware of a numbness on her right side, and one day when walking across the floor she fell. She did not lose consciousness, but found she could not speak, and that her right side was powerless. Her speech gradually improved, and she recovered almost completely the use of her limbs.

*Examination*.—Intelligence good. Urine contains albumen.

*Face*.—No facial paralysis. *Sensation* perfect.

*Special Senses*.—*Sight* equal and good in both eyes. *Hearing* equal and good on both sides. *Smell* diminished on right side. *Taste* diminished on both sides.

*Upper Extremity*.—Voluntary movements perfect. No obvious rigidity save in exaggerated radial and deltoid reflexes. Grasp inferior to left. *Sensation* appears very little affected.

*Trunk*.—*Sensation* appears very little affected.

*Lower Extremity* has a slight drag in walking. Knee jerk is well marked. *Sensation* appears almost perfect.

*Diagnosis*.—Left capsular haemorrhage: involvement of sensation evidenced only by partial anosmia and diminished taste.

### CASE XVII.

M. M., female, aet. 60.

*History*.—Four years ago, on coming home after a day's work, the patient suddenly perceived she could not use her left side, though she did not lose consciousness. She lay up for three months, and then recovered so far as to walk about, but she could never use her arm again. *Family History*.—Brother suffered from hemiplegia.

*Examination*.—Intelligence fair. Arteries very tortuous. No albumen in urine.

*Face*.—No facial paralysis. *Sensation* slightly impaired to touch, pain, and temperature.

*Special Senses.*—*Sight.*—Diminished visual acuity in the left eye. *Hearing.*—Watch heard only when pressed against left ear. Heard 2 inches from right. *Taste.*—Diminished on left side. *Smell.*—Diminished on left side.

*Upper Extremity* very rigid. No voluntary movement. Tactile, thermal, and painful sensation all slightly diminished, especially over the hand. Muscular sense is much impaired.

*Trunk.*—All sensations diminished slightly.

*Lower Extremity* is also rigid, and knee jerk is well marked. Very little voluntary movement. *Sensation* is diminished to all stimuli, and muscular sense is much impaired.

*Diagnosis.*—Right capsular haemorrhage involving both motor and sensory paths.

### CASE XVIII.

M. B., female, aet. 41.

*History.*—About twelve months ago the patient fell down in the street, and, though she was not unconscious, she could not rise owing to loss of power on the right side. She was assisted home, remained in bed for ten days, and then gradually recovered. Her speech was defective at first, but evidently rather in the direction of difficulty in articulation than from aphasia.

*Examination.*—Intelligence fair. Speech somewhat slurred and hesitating.

*Face.*—No paralysis. Sensation slightly diminished on right side.

*Special Senses.*—*Sight* appears equal in both eyes. *Hearing.*—Diminished on right side. *Taste.*—Lost on right side of tongue. *Smell.*—Diminished, but present on right side.

*Upper Extremity* is slightly rigid, and radial and deltoid reflexes are well marked. Grasp is inferior to that of left hand. *Sensation.*—Tactile sensation absent over hand and diminished over arm. Painful sensation is present all over, but impaired. Thermal sense is affected in that the patient feels both hot and cold tubes as cold. Muscular sense is defective.

*Trunk.*—All sensations are definitely impaired.



*Lower Extremity* is rather rigid, and knee jerks are well marked. Distinct drag in walking. *Sensation* is affected as in arm, but to a greater extent. Tactile, thermal, and painful senses are all absent over the foot, and much diminished over the thigh and leg. Muscular sense is diminished.

*Diagnosis.*—Left capsular haemorrhage involving sensory as well as motor path; partial recovery—descending degeneration.

### CASE XLV.

M. R., female, aet. 58.

*History*—About fifteen months ago the patient had her right arm amputated for “blood poisoning,” and six weeks after the operation she suddenly lost consciousness while lying in bed. On recovery, she found she could not move her right leg, that her whole right side felt quite numb, and that she could not express herself in speech. She has never been able to use the leg since, though her speech has improved.

*Examination.*—Intelligence fair.

*Face.*—Slight right paralysis evident. *Sensation* is impaired to all stimuli, but present.

*Special Senses.*—*Sight.*—Diminished visual acuity in right eye. *Hearing.*—A watch is heard only when pressed against the right ear. Heard 10 inches from left. *Taste.*—Diminished on right side. *Smell.*—Diminished on right side.

*Trunk.*—Sensation impaired all over right side.

*Lower Extremity* is rather rigid. Knee jerk on the right is well marked, and ankle clonus is present. Very little voluntary movement is possible. *Sensation* is diminished to all stimuli all over, especially on the dorsum of the foot, and muscular sense is impaired.

*Diagnosis.*—Haemorrhage from the left lenticulo-striate artery, affecting also the sensory division of the capsule. Hearing is apparently unaffected on the sound side.

### CASE XLV.

M. S., female, aet. 60.

*History.*—About six years ago, as the patient was scrubbing a floor, she suddenly found she could not rise. After several

attempts she got up, and proceeded to bathe her left hand as it felt numb and tingling. While doing so, she fell down and remained on the floor until lifted by a neighbour. She was never unconscious, and her face does not seem to have been affected, nor was her speech, but she could not move her left arm or leg. She has been bed-ridden ever since, as her leg never recovered sufficiently for her to move about. *Family History*.—An uncle, a brother, and a sister have all suffered from “apoplexy.”

*Examination*.—Intelligence good.

*Face*.—No facial paralysis. No arcus senilis. *Sensation* appears perfect.

*Special Senses*.—*Sight* does not appear affected, being equal and good on both sides. *Hearing*.—Equal on both sides, but diminished in power. A watch is heard only when placed against each ear. *Taste*.—Appears perfect. *Smell*.—Appears perfect.

*Upper Extremity* lies at the side, supinated, with the fingers flexed on the palm. Voluntary movement is very defective, the upper arm only being movable to a slight extent. The arm can be almost fully extended on passive movement, but feels very rigid. Grasp is fair. Radial reflex exaggerated, but deltoid is not obtained. *Sensation*.—Tactile sense appears to be present to some extent all over the arm and hand, though, in the latter localization is defective, the patient invariably referring a touch on the fingers or hand to the forearm. Pain sense is also diminished, a pin prick being appreciated only when applied with some force. Thermal sense is very defective all over, the cold tube being occasionally recognized, but the warm almost never. Muscular sense also deficient, the patient recognizing that a finger is moved, but never which finger. She does not appreciate a change in position of the arm, nor are different weights perceived.

*Trunk*.—Sensation is rather less impaired than in the arm, but localization is defective, and occasionally a touch on the side is referred to the arm. Thermal and painful sensations are also defective.

*Lower Extremity* is very rigid, and there is practically no voluntary movement. Knee jerk well marked on left side,

and slight ankle clonus is obtained. Plantar reflex is exaggerated, and Babinski's toe phenomenon is elicited. *Sensation*.—Tactile present to some extent all over thigh and leg, but a touch on the dorsum of the foot is invariably referred to the lower third of the leg, and one on the sole is referred to the dorsum of the foot. Thermal sense not much affected over the thigh, but the hot tube is never recognized over the leg and foot, and the cold but seldom. Painful sense is affected as in arm. Muscular sense is defective in that patient cannot tell which toe is moved, and has no power to appreciate different weights laid on the leg or foot.

*Diagnosis*.—Right capsular haemorrhage involving both sensory and motor paths; secondary descending degeneration. The sensory paths being obviously involved, the very slight impairment of the special senses is remarkable.

### CASE XVI.

J. C., female, aet. 55.

*History*.—About a year ago the patient woke one morning and found she could not move her right arm or leg, and that her whole side felt numb. She could only mumble, but could say what she wanted. Her face was not affected, and she was never unconscious. She improved in a short time, but has never quite regained the power of her right side.

*Examination*.—Intelligence fair.

*Face*.—No facial paralysis. *Sensation* appears unaffected.

*Special Senses*.—*Sight* equal and good in both eyes.

*Hearing*.—Diminished on right side: good on left. *Taste*.—Equal and good on both sides. *Smell*.—Equal and good on both sides.

*Upper Extremity* has free voluntary movement, though it cannot be quite fully extended. The grasp is inferior to that on the left side, and the radial and deltoid reflexes are much exaggerated. *Sensation*.—Tactile, thermal, and painful perception diminished all over hand and arm, and localization is defective. The cold tube is occasionally recognized. Muscular sense appears perfect.

*Trunk*.—Sensation appears almost perfect.



*Lower Extremity* can be freely moved. Knee jerks are exaggerated and ankle clonus obtained on both sides. Babinski's sign present in left foot. *Sensation* affected to about the same extent as in the arm, as regards perception of touch, pain, and temperature. Muscular sense appears perfect.

*Diagnosis.*—Left capsular haemorrhage, the lesion having involved sensory as well as motor fibres in internal capsule. Here, again, the special senses are unaffected in a lesion which has obviously implicated the power of general sensation.

### CASE XXII.

W. B., male, aet. 43.

*History.*—Two months ago the patient suddenly fell down while walking across the room. He lost consciousness, and on recovery found he could not move his right side nor say what he wanted. The aphasia gradually improved, and he has also since regained the power of his limbs to a great extent.

*Examination.*—Intelligence fair.

*Face.*—Slight right paralysis. *Sensation* to all stimuli rather dulled on right side.

*Special Senses* do not appear to be affected, taste and smell being normal, while the patient can see and hear equally well on both sides.

*Upper Extremity.*—Fair amount of voluntary movement, no obvious rigidity, grasp less than left. *Sensation* to all stimuli is diminished over the arm, and tactile sense appears absent on the hand. Muscular sense is impaired as far as the movements of the fingers are concerned.

*Trunk.*—Sensation slightly impaired all over.

*Lower Extremity* is more rigid than arm, and knee jerks are exaggerated and ankle clonus present on both sides. *Sensation* is diminished all over as in arm, and lost to all stimuli over foot. Muscular sense appears gone.

*Diagnosis.*—Haemorrhage from the left lenticulo-striate artery, involving principally the leg, arm, and the sensory division of the capsule, though the nerves of special sense appear to have escaped.

## CASE XXIII.

J. C., female, aet. 35.

*History*.—For the past five years the patient has been troubled with dyspnoea and palpitation, becoming worse from time to time, and coming on first after an attack of rheumatic fever, for which she was laid up for six weeks. A week before admission, as she was lifting a chair she suddenly fell down unconscious, and on regaining her senses found she had lost the power of her left side. The speech was not affected. She was brought to the infirmary, and since then has improved, being now able to move the leg to a certain extent.

*Examination*.—Intelligence good. Rough presystolic murmur leading up to a loud first sound. Reduplication of the second sound at the apex.

*Face*.—Slight left facial paralysis evident. *Sensation* perfect.

*Special Senses*.—Not affected.

*Upper Extremity* lies flexed across the chest, with the wrist and fingers also flexed. Secondary rigidity marked. *Sensation* perfect.

*Lower Extremity* lies extended and rigid. Knee jerk is not obtained, but Babinski's toe phenomenon is present.

*Diagnosis*.—Embolism of the lenticulo-striate branch of the middle cerebral artery affecting the anterior two-thirds of the posterior limb of the internal capsule. The posterior third is not involved.

## CASE XXIV.

J. H., male, aet. 45.

*History*.—The patient was admitted a week ago suffering from a large aneurysm of the ascending arch of the aorta, which had existed for six years, but had latterly become larger. Three days after admission he suddenly developed a right hemiplegia accompanied by motor aphasia. On examination at this time no affection of sensation was observed, and a diagnosis of embolism of the lenticulo-striate artery was made. After several days sensory symptoms began to appear, the first being sensory aphasia, which unfortunately prevented



any accurate estimation of the degree of anaesthesia. There was, however, without doubt a hemianaesthesia of the right side, and the patient gradually became comatose and died.

*Post Mortem.*—An embolus was indeed found in the lenticulo-striate artery, and extending backwards from this to the circle of Willis; and involving the lenticulo-optic artery in passing, was a distinct thrombus, this accounting for the gradual onset of sensory symptoms after the sudden occurrence of the motor phenomena.

### CASE XXV.

R. S., female, aet. 17.

*History.*—About two years ago the patient first noticed a tingling sensation in her left leg. This lasted about a month, and was accompanied by a feeling of weakness in the limb. The leg then began to twitch, the knee and the ankle flexing and extending, but the toes not moving. She gradually lost all power in the leg, but has since regained some degree of voluntary movement. About a year ago the left arm became affected with a similar numb sensation, and subsequent twitching and weakness. This was accompanied by a peculiar "creeping" sensation in the face, especially on the left side, and most marked near the mouth. About two months ago her tongue and mouth began to feel numb, and she could not take milk into her mouth without spilling it. At this time she could scarcely make herself understood, as she mumbled in her speech. This condition has since improved; but her eyesight has failed gradually, so that she is now totally blind. Headache and vertigo have been marked since the onset of her illness, and occasional sickness has occurred.

*Examination.*—Intelligence good.

*Face.*—Slight left facial paralysis. Sensation very little affected.

*Special Senses.*—Patient is totally blind from post-neuritic optic atrophy. Other senses unaffected.

*Upper Extremity.*—Fair amount of voluntary movement. The fingers are hyper-extended at the first phalangeal and flexed at the terminal joint. There is practically no grasp. Radial and deltoid reflexes present. *Sensation.*—Tactile sensa-

tion is appreciated all over the left arm and hand, and localization is perfect, but the feeling is more dull than on the right side. Pain and thermal sense is also diminished, but present. Muscular sense is defective. The patient occasionally knows which finger is moved, but has no idea in which position the arm is placed.

*Trunk.*—Sensation affected as in arm.

*Lower Extremity.*—Voluntary movement is good, but there is little strength in the limb. The leg gives an occasional twitch, consisting of a flexion of the knee, especially if suddenly touched on the calf. *Sensation* is affected in all forms to about the same extent as in the arm.

*Operation on May 30th.*—A piece of bone  $2\frac{1}{2}$  inches in diameter was removed from the right parietal region, and the dura was found thickened and the brain bulged through the wound. A tumour was found covered with a thin layer of cortex. The lower angle of the wound was penetrated by the finger to find the lower edge of the tumour, which was diffuse and could not be excised. The specimen removed was found to be a gliosarcoma.

On examination of the patient on June 4th there is much more distinct facial paralysis than before; and sensation, if anything, is rather more dull.

*The Upper Extremity* is much more markedly paralysed as to voluntary motion, the patient being unable to raise it from the bed. *Sensation*, as a whole, is much more impaired. A light touch is not felt at all over the arm and hand, and localization is often inaccurate. Pain and thermal sense are also affected, and muscular sense is gone.

*The Lower Extremity* does not appear to have been so much affected by the operation, the condition being practically as at the previous examination.

## CASE XXVI.

B. T., female, aet. 58, was admitted with what was found later to be a depressed fracture of the left parietal bone. A few days after admission she complained of numbness of the right leg, but on examination no defect of sensation could be

made out. She gradually lost the power of voluntary movement in the leg, and twitching began in the right arm, while her speech became indistinct, so that she called "leg" "edge." On examination of sensation on the affected side, I found it diminished in all its forms, but especially with regard to tactile sensibility, an ordinary touch being quite unappreciated and localization defective. In testing thermal sense the patient several times failed to recognize either heat or cold, but occasionally she appreciated the cold tube, though never the warm. Muscular sense in the arm was difficult to test, as the patient had also a Colles' fracture, but in the leg it was impaired, though not absent. Pain sensation was present, but dulled. These sensory defects were most marked in the leg, to a less degree on the right side of the trunk, while sensation appeared unaffected in the face. The special senses were unaffected, but optic neuritis was present. On the following day the skull was trephined, and a spicule of bone was removed, which was found pressing down into the motor area. The condition of cutaneous sensation appeared practically unaltered after the operation, and the patient died six days later. On examination of the site of the injury septic softening was found in the ascending frontal and ascending parietal convolutions, and apparently confined to this area of the cortex.

### CASE XXVII.

G. C., male, aet. 50, lead worker.

*History.*—After working in lead works as a labourer for more than a year without any of the usual symptoms of plumbism, the patient was suddenly seized with a numb sensation all down the left side. He then became unconscious. On recovery he was evidently suffering from lateral hemianopia, as he complained of one-sided blindness. He was sent to the infirmary, when the left leg, arm, and angle of the mouth began to twitch. This condition improved after three weeks, but has come on again, and has continued more or less ever since, the period of onset being about eighteen months ago. His right side has never been affected in any way. No albuminuria and no cardiac lesion.



*Examination.*—The left side of the face twitches almost continually, while the left fingers are alternately flexed and extended, and the knee is also bent and straightened. The tongue is protruded markedly toward the left and is tremulous. *Sensation* slightly diminished to all stimuli.

*Special Senses.*—Left lateral hemianopia marked; smell, taste, and hearing not affected.

*Upper Extremity.*—Light touches are not felt at all, and on heavier pressure the localization is sometimes defective. Pain sensation is dulled. The patient recognizes the cold tube immediately, but constantly fails to appreciate heat; muscular sense perfect.

*Trunk.*—Sensation is slightly dulled all over.

*Lower Extremity.*—Affected to the same degree as the arm, except that there is markedly diminished pain sense.

*Diagnosis.*—Cortical irritation of some kind, evidenced by the twitching, by the slight affection of general sensation and the absence of involvement of the special senses, save for the hemianopia.

In twenty-four of this series of cases of hemiplegia the lesion is presumably in the internal capsule, while in three instances the motor cortex is the part affected. I now propose to consider in detail the extent of involvement of sensibility in these cases, as regards both the nerves of special sense and those concerned with the conveyance of general sensation.

*Involvement of the Olfactory Nerve.*—It is generally admitted that the uncinate gyrus represents the destiny of the olfactory nerves, but as regards the decussation of the fibres on their way thither, clinical observations differ somewhat from experimental and anatomical evidence. Ferrier<sup>1</sup> has found by experiment that in the monkey destruction of one uncinate gyrus causes anosmia *on the same side* and has stated his belief "that there is no anatomical basis of cross connection between the olfactory bulbs and their cerebral centres." But elsewhere<sup>2</sup> he says that though the outer root of the olfactory nerve can be traced to the subicular region of the same side,

<sup>1</sup> Ferrier, *Functions of the Brain*, p. 185.

<sup>2</sup> Ferrier, *British Medical Journal*, 1878, vol. i., p. 558.



yet the inner may pass to the other hemisphere, though so far it has not been traced further than the corpus striatum. Testut,<sup>1</sup> however, describes "crossing fibres" passing from one olfactory bulb to the temporal lobe of the opposite side; and Turner<sup>2</sup> thus epitomizes what is known of the intra-cerebral course of the olfactory fibres:

1. A certain number cross, forming the pars olfactoria of the anterior commissure.
2. Many pass to the uncinate gyrus of the same side.
3. Some fibres are to be found in the neighbourhood of the internal capsule and optic thalamus.
4. A part of the anterior commissure forms a connecting strand between the hippocampal lobes of the opposite sides.

So far as personal observation goes, I find clinical evidence to be quite in favour of at least a partial decussation of the olfactory fibres in the cerebrum, as lesions affecting the sensory division of the internal capsule cause either complete or incomplete anosmia on the side opposite the lesion. In the above 24 cases eight are found to be suffering from complete anosmia, while eleven show diminished perception of smell on the same side as the hemiplegia. In no case is there any loss or obvious diminution of the sense on the same side as the cerebral lesion, and in the numerous recorded instances of similar cases this seems also to have been the condition observed.

Ferrier<sup>3</sup> has attempted to explain the occurrence of the anosmia on the hemiplegic side by suggesting that it may be due to the loss of common sensibility of the fifth nerve, in addition to the probable crossing of a few of the olfactory fibres through the anterior commissure. Bastian,<sup>4</sup> however, states that an affection of the intra-cerebral roots of the fifth nerve probably does not affect the sense of smell at all; and he believes the anterior commissure to have important functions of some kind in the conveyance of this sense.

The question thus appears to be whether the number of olfactory fibres crossing in the anterior commissure is suffi-

<sup>1</sup>Testut, *Anatomy of Brain and Spinal Cord*, Ed. 1900, vol. ii., p. 723.

<sup>2</sup>Turner, *System of Medicine*, by Allbutt, vol. vi., p. 753.

<sup>3</sup>Ferrier, *British Medical Journal*, 1878, vol. i., p. 558.

<sup>4</sup>Bastian, *Paralysis: Cerebral, Bulbar, and Spinal*, p. 380.

ciently great to explain the opposite anosmia in capsular lesions. Ferrier's explanation appears to me quite inadequate, inasmuch as the complete loss of smell so frequently met with clinically is often out of all proportion to the severity of the involvement of the trigeminal. In Case III. the nerves of general sensation are practically unaffected, while the olfactory sense is entirely abolished on the same side, and this without any discoverable defect in the external nasal apparatus. In Cases II., IV., V., VII., VIII., complete anosmia is associated with a general diminution, but no loss, of common sensibility: and in Case I. only is the fifth nerve affected to so great an extent as to give any degree of feasibility to such an explanation.

From a consideration of capsular lesions, therefore, it is probable that the cortical centre for smell is situated on the side opposite to the peripheral distribution of the olfactory nerves. There appears to be forthcoming little or no satisfactory and convincing proof that an isolated lesion of one uncinate gyrus, apart from any involvement of the olfactory tract or bulb, will produce an anosmia of the same side rather than a perversion of the sense of smell (Turner, *op. cit.*). Anosmia pure and simple is evidently most commonly and most completely the result of a lesion in the sensory division of the internal capsule, thus indicating the existence therein of fibres with a definitely olfactory function. This conclusion is borne out by the fact that in hysterical hemianaesthesia, which is the result of a functional rather than of an organic change in the "sensory crossway," anosmia is included in the phenomena observed.

Thus it seems fair to conclude that though there may, and probably does, exist a direct connection between the olfactory cortex and the periphery, nevertheless the crossed fibres play the more important part in connection with the conveyance of olfactory sensation.

*Involvement of the Optic Nerve.*—From a consideration of the relation of the visual cortical centres to the retina, the main symptom to be expected in a lesion affecting the optic radiations or pulvinar is lateral homonymous hemianopia. This phenomenon, however, I have observed in two instances only of capsular hemiplegia. In six cases visual acuity is diminished on the affected side, and in three cases there is found crossed

amblyopia, consisting of contracted visual field, diminished visual acuity, and altered perception of colour. Von Graefe formerly held the view that absolutely unilateral lesions of the cerebrum did not cause crossed amblyopia, but rather homonymous hemianopia. Charcot,<sup>1</sup> however, insisted that "lesions of the cerebral hemisphere producing hemianaesthesia likewise determine crossed amblyopia"; and Bastian (*op. cit.*, p. 134) remarks that unilateral amblyopia has a distinct localizing value when it is associated with hemianaesthesia, the lesion being then in the posterior third of the internal capsule. Percival,<sup>2</sup> while admitting that crossed amblyopia may occur in connection with hemianaesthesia, attempts to explain the apparent anomaly in much the same way as Ferrier explains crossed anosmia, viz., by attributing most of the phenomena to the implication of the fifth nerve. He believes it possible, as Gowers suggests, that there is a communication between the centres of the optic and trigeminal nerves, so that any excitation of the centre of the fifth may alter the sensibility of that for vision. As an example of this he cites the amblyopia arising from dental irritation of the trigeminal. But, so far as I can learn, no communication has ever been anatomically traced between the centres for the optic and trigeminal nerves. Such a theory might be sufficient to explain the diminished visual acuity in the affected eye, but the involvement of the fifth nerve in the above series of cases is so slight as to preclude any idea of a secondary influence on the optic centres sufficient to produce amblyopia. And in the example quoted—of amblyopia following dental irritation of the trigeminal—the effect on the optic nerve is presumably an irritative one, while that in hemianaesthesia is paralytic, and it is difficult to imagine two such lesions resulting in the same peripheral manifestation.

Gowers<sup>3</sup> suggests that the occurrence of crossed amblyopia in hysterical hemianaesthesia indicates the existence of a *functional* centre, capable of being inhibited, in which is represented the whole field of one eye, and not the half fields of

<sup>1</sup> Charcot, *Localization of Cerebral and Spinal Diseases*, p. 108.

<sup>2</sup> Percival, Paper read to Northumberland and Durham Medical Society in 1892.

<sup>3</sup> Gowers, *Diseases of the Brain*, p. 24.



both eyes. Granting this, it is reasonable to argue that exactly similar peripheral evidences may be produced by pathological lesions affecting the same locality.

If, as Foster<sup>1</sup> says, the external geniculate bodies are connected with the maculae luteae, and fibres pass from these bodies to the internal capsule, these fibres are probably connected with the maculae. Now, it is believed that each macula is projected on to the opposite cuneus; and if this be the case, it is quite sufficient to explain the occasional occurrence of crossed amblyopia rather than hemianopia in lesions of the posterior division of the internal capsule.

*Involvement of the Trigeminal or Glossopharyngeal.*—In considering the affections of the sense of taste in connection with capsular lesions, I have thought it wiser to do so under such a heading, opinions being still divided as to which of these nerves is responsible for the conduction of taste impressions to their cortical destination.

Owing to the difficulty of satisfactorily testing the sense of taste, especially on the posterior part of the tongue, clinical observations lose something of their value. But in eight of the above cases I was able to demonstrate total ageusia on the hemiplegic side, and in eleven a marked diminution of the sense. In no case was there a total anaesthesia of the head and face indicating an involvement of the sensory fibres of the fifth nerve to such an extent as to produce complete ageusia in addition to the other sensory manifestations. Thus, if the trigeminal be supposed to be the special nerve of taste, it is obvious that the fibres conveying impressions of taste take a separate course on their way to the cortex from those which conduct general sensation.

*Involvement of the Auditory Nerve.*—Though the superior temporal lobe is generally admitted to be the cortical centre for hearing, yet it has been found that destruction of this lobe on one side apparently does not cause complete crossed deafness, but rather a marked diminution in hearing on the opposite side from, and a slighter diminution on the same side as the lesion.<sup>2</sup> This statement is borne out by a study of

<sup>1</sup> Foster's *Physiology*, pt. iii., p. 1166.

<sup>2</sup> Collins, *Twentieth Century Practice of Medicine*, vol. x., p. 55.



capsular lesions, in which a large proportion of patients give evidence of some impairment of auditory perception on both sides. In twelve of my cases I found diminished hearing in both ears. Of these, five suffered from complete deafness on the hemiplegic side, while seven showed a much more marked impairment of the sense than was evident on the sound side. The hearing in six of the remaining cases was diminished on the hemiplegic side alone, while in four instances only was it entirely unaffected in either ear. This would seem to suggest a bilateral representation of auditory perception to some extent, the principal cortical centre being situated on the side opposite to the peripheral distribution of the auditory nerve. It is clear that the auditory fibres travel in the posterior limb of the internal capsule, and the inference therefore is either that their decussation is not complete or that some strands of fibres cross twice on their way to the cortex.

*Involvement of Nerves of General Sensation.*—This comprises such nerves as convey impressions of touch, pain, temperature, and muscular sense from the periphery to the cerebrum. These nerves are affected to a greater or less extent according as the site of the lesion is capsular or cortical. If the entire posterior limb of the capsule be involved a typical hemianaesthesia results, and four cases of this kind were described by Türk as early as 1859.<sup>1</sup> Clinically, however, it is comparatively rare to find a quite typical hemianaesthesia, and in the above series of 24 capsular lesions, general and special sensation was affected in 16 cases only. Of the remainder, three were cases in which, with practically no impairment of general sensation, the special senses were obviously diminished in acuity. The remaining 3 cases showed diminished general sensation without any impairment of the special senses.

The variable degree to which sensibility was involved is approximately as follows:

*The Sense of Temperature* presented some variety in its impairment, that for heat being evidently much more readily affected than that for cold, in lesions implicating the internal capsule. In nineteen patients in whom this sense was defective, ten were cases in which the cold tube was almost invari-

<sup>1</sup> Sturge, *British Medical Journal*, 1878, p. 783.

ably recognized, while the hot test was not appreciated at all, even when water, warm enough to be almost painful, was used. Generally speaking, it appeared that if the hot test were correctly appreciated by the patient, the cold tube presented no difficulty, and thus the sense of temperature as a whole was but little affected, though both kinds of thermal sense might be less acutely felt than on the sound side.

*Tactile Sensation* appeared to be impaired to the greatest extent, being more or less implicated in the entire series of cases, though sometimes to a very slight degree. In such instances only the lightest touches were unrecognized, and the sense of localization was perfect, though transmission of impression was delayed. In the more marked cases, where an ordinary touch was unappreciated, the sense of localization was not so accurate, and such patients generally gave evidence also of some impairment of their

*Muscular Sense.*—This appeared to be implicated in direct ratio to the severity of the tactile anaesthesia, being entirely unaffected in the milder cases, and markedly involved in the more severe types.

*Pain Sensation* appeared more or less impaired in all those patients who gave evidence of tactile anaesthesia. The analgesia, however, was less obvious than the affection of touch, being practically nil in the less severe cases, and but seldom complete even in definitely anaesthetic areas. In no instance did I find any impairment of the sense of pain apart from that of touch, though there are recorded various cases illustrating such a condition.<sup>1</sup> Paget<sup>2</sup> believes the senses of pain and temperature to be the most readily and the most permanently affected in any lesion of the brain or cord, and he suggests that the paths for these senses lie close together entirely apart from the tract conveying impressions of touch. This, however, I have not observed, but rather that tactile and muscular senses are most intimately associated, that pain sensation to a less degree is connected with touch, and that temperature apparently is distinct from either and may be affected independently of both.

<sup>1</sup> *British Medical Journal*, 1882, vol. i., p. 781; *ibid.*, 1888, vol. i., p. 1008.

<sup>2</sup> Paget, *British Medical Journal*, 1889, vol. i., p. 1.

It is more than probable that each form of general sensation travels by a pathway of its own in the sensory crossway; but clinically it appears that the tracts conveying impressions of touch and of pain lie near one another, and thus a capsular lesion large enough to result in analgesia almost certainly produces in addition a marked degree of tactile anaesthesia.

It seems to be a very generally accepted theory that sensation is only temporarily affected in lesions of the internal capsule; and Osler<sup>1</sup> says, "In hemiplegia, disturbance of the special senses is not common"; and again,<sup>2</sup> that "Hemianaesthesia is rare in hemiplegia. Slight numbness or tingling may be present, or there may be loss of sensation after a day or two, which gradually passes of." Dana<sup>3</sup> states that, "In a good many cases there is a slight amount of hemianaesthesia during the early stage of cerebral apoplexies, but this almost invariably disappears in a few days or weeks, and it is rare that any anaesthesia of cutaneous or muscular sense is observed." Nothnagel,<sup>4</sup> on the other hand, says, "From my own experience I am inclined to believe that incomplete restoration [of sensation in hemiplegia] is oftener met with than is generally believed"; and with this opinion my observations entirely coincide. It is well known that sensory fibres resist pressure better than do motor, and thus perception of sensation appears to return after a lesion more quickly than the power of voluntary movement. But in a capsular haemorrhage, where the posterior third of the posterior limb has been involved to any extent, it does not seem possible for sensation to be entirely regained by the patient. In explanation of its partial recovery it is a feasible supposition that such fibres as are stretched or compressed may recover as the compressing blood clot absorbs, while such as are lacerated give rise to permanent impairment of sensation, and it must be seldom indeed that all escape. This fact may serve as a point of differential diagnosis between haemorrhage and embolism of the lenticulo-striate artery, and Cases XXIII. and XXIV. illustrate this in different ways.

<sup>1</sup> Osler, *Principles and Practice of Medicine*, p. 946.

<sup>2</sup> Osler, *Theory and Practice of Medicine* (Pepper), vol. i., p. 635.

<sup>3</sup> Dana, *Twentieth Century Practice of Medicine*, vol. x., p. 280.

<sup>4</sup> Nothnagel, *Cyclopedia of Practice of Medicine*, p. 128.



In the former there was absolutely no affection of sensation, though the hemiplegia was of comparatively recent date, and the lesion was obviously an embolus in the lenticulo-striate artery, affecting only the anterior two-thirds of the posterior limb of the capsule. In Case XXIV. an embolus was also the apparent diagnosis, but was not sufficient to explain the occurrence of such marked sensory phenomena, which suggested a wider site for the lesion and increased the gravity of the prognosis.

That sensation is involved to any extent in a hemiplegia resulting from a lesion confined to the motor cortex is denied by many authorities. Ferrier<sup>1</sup> believes such affection of general sensibility to be due to the involvement of the hippocampal lobe secondarily by the fibres of the cingulum. But that the Rolandic area is also the chief centre for the perception of cutaneous sensation is generally believed among American and German writers (except Meynert). In fact Munk and Schiff<sup>2</sup> suggested that the so-called motor centres were not motor at all, but that in this region were stored memories of sensation associated with certain movements which are reflexly produced when the centre is stimulated; and this corresponds to some extent to the views expressed by Bastian (*op. cit.*), who considers the Rolandic area to be the kinaesthetic centre—that is, the centre for “unconscious impressions from muscles which seem to be so intimately connected with the production of movements.”

Apart, however, from an unqualified acceptance of such a theory, a study of Cases XXV., XXVI., and XXVII. indicates at least some involvement of general sensation in an essentially motor lesion. In this connection, Case XXVI. is of most interest in that a definite affection of cutaneous sensibility was associated with a lesion demonstrated *post mortem* to be confined to the Rolandic area. Here sensation was diminished to some extent in all its forms, but the impairment was most marked in the appreciation of tactile impressions. This is so

<sup>1</sup> Ferrier, *Brain*, 1883, vol. vi., p. 67; also *System of Medicine* by Allbutt, vol. vii.; also Croonian Lectures, *British Medical Journal*, 1890, vol. ii.; also *Localization of Cerebral Disease*.

<sup>2</sup> *Lancet*, 1883, vol. ii., p. 822.



also in lesions affecting the posterior third of the internal capsule, and suggests that the same fibres are involved in both cases. That the anæsthesia in this case was less profound than that which would result from a capsular lesion of the same recent date is explained by the fact that in the cortical lesion only the diffuse terminations of the sensory nerves are affected, while in the capsule the lesion involves the aggregation of fibres forming the sensory crossway.

In Case XXVII., again, the irritation is evidently in the Rolandic area and is accompanied by a distinct diminution of sensibility on the affected side; and this condition I have frequently observed following as well as preceding an attack of epilepsy which had begun with twitching of the thumb or great toe.

In Case XXV. the gliosarcomatous tumour probably extended beyond the motor cortex, and so this can scarcely be cited as an example of affection of cutaneous sensation following a lesion in the Rolandic area. But that the tumour did not involve the capsule is almost certain, as the special senses were not in any way affected, except for the blindness which was evidently due to the accompanying hydrocephalus. In Case XIII., on the other hand, though the diagnosis of cerebral tumour was equally obvious, the very evident diminution of smell, taste, and hearing on the affected side indicated an involvement of the capsule, and the greater affection of general sensibility suggested also this site for the lesion.

TABLE OI

Case.	Sex.	Age.	Hemi- plegia.	EXTENT OF IMPAIRMENT OF GENERAL SENSATION.			
				Face.	Arm.	Trunk.	Leg.
1.	F.	49	Left	Much dulled	Hand lost, arm impaired	Dulled	Foot lost, le impaired
2.	M.	60	Right	Perfect	Slightly dulled	Dulled	Much in paired
3.	F.	67	Right	Perfect	Almost per- fect	Almost per- fect	Almost pe fect
4.	F.	68	Right	Dulled	Hand lost, arm impaired	Dulled	Foot lost, le impaired
5.	F.	67	Right	Slightly dulled	Slightly impaired	Dulled	Slightly dulled
6.	M.	39	Left	Dulled	Dulled	Dulled	Dulled
7.	M.	21	Left	Dulled	Dulled	Dulled	Dulled
8.	F.	63	Right	Dulled	Dulled	Dulled	Dulled
9.	M.	75	Left	Slightly dulled	Dulled	Slightly dull	Dulled
10.	F.	33	Left	Slightly dulled	Dulled	Dulled	Dulled
11.	M.	64	Left	Slightly dulled	Dulled	Dulled	Dulled
12.	F.	56	Left	Perfect	Hand lost, arm impaired	Dulled	Much in paired
13.	M.	11	Right	Perfect	Impaired	Impaired	Foot lost, le impaired
14.	F.	64	Left	Perfect	Dulled	Dulled	Dulled
15.	F.	50	Left	Perfect	Almost per- fect	Almost per- fect	Almost pe fect
16.	F.	56	Right	Perfect	Almost per- fect	Almost per- fect	Almost pe fect
17.	F.	60	Left	Dulled	Dulled	Dulled	Dulled
18.	F.	41	Right	Dulled	Much im- paired	Dulled	Much in paired
19.	F.	58	Right	Dulled	Dulled	Dulled	Dulled
20.	F.	60	Left	Perfect	Much im- paired	Dulled	Much in paired
21.	F.	55	Right	Perfect	Dulled	Dulled	Dulled
22.	M.	43	Right	Dulled	Dulled	Dulled	Dulled
23.	F.	35	Left	Perfect	Perfect	Perfect	Perfect
(24.)	M.	45	Right	Dulled ?	—	—	—
(25.)	F.	17	Left	Dulled	Impaired	Impaired	Impaired
(26.)	F.	58	Right	Slightly dulled	Impaired	Impaired	Impaired
(27.)	M.	50	Left	Slightly dulled	Impaired	Impaired	Impaired

CASES.

EXTENT OF INVOLVEMENT OF SPECIAL SENSES.				Lesion.
Light.	Smell.	Taste.	Hearing.	
amblyopia	Lost	Lost	Diminished	Capsular
cataracts	Lost	Diminished	Diminished	Capsular
acuity diminished	Lost	Lost	Diminished	Capsular and optic thalamus
amblyopia	Lost	Lost	Lost	Capsular
cataracts	Lost	Lost	Much diminished	Capsular
amblyopia	Lost	Lost	Diminished	Capsular
blindness	Lost	Lost	Much diminished	Capsular
hemianopia	Lost	Lost	Lost	Capsular and optic thalamus
acuity diminished	Diminished	Diminished	Lost	Capsular
hemianopia	Diminished	Diminished	Equal and good	Capsular
acuity diminished	Diminished	Diminished	Diminished	Capsular
acuity diminished	Diminished	Diminished	Equal and good	Capsular
optic neuritis	Diminished	Diminished	Diminished	Capsular—optic thalamus corpus striatum
blindness	Diminished	Diminished	Diminished	Capsular
equal and good	Diminished	Diminished	Diminished	Capsular
equal and good	Much diminished	Diminished	Equal and good	Capsular
acuity diminished	Diminished	Diminished	Much diminished	Capsular
equal and good	Diminished	Lost	Slightly diminished	Capsular
acuity diminished	Diminished	Diminished	Much diminished	Capsular
equal and good	Equal and good	Equal and good	Much diminished	Capsular
equal and good	Equal and good	Equal and good	Diminished	Capsular
equal and good	Equal and good	Equal and good	Equal and good	Capsular
equal and good	Perfect	Perfect	Perfect	Capsular (Emb.)
—	—	—	—	Capsular
blindness	Equal and good	Equal and good	Equal and good	Cortical
optic neuritis	Equal and good	Equal and good	Equal and good	Cortical
left lateral hemianopia	Equal and good	Equal and good	Equal and good	Cortical?

## CONCLUSION.

On reviewing the subject of sensory phenomena in hemiplegia it seems justifiable to conclude that general and special sensation is more often impaired after a capsular lesion, even when the lesion is of old standing, than is usually supposed.

Many hemiplegias, whether of capsular or of cortical origin, present such definite and unmistakable signs of motor paralysis that the more subjective sensory phenomena are apt to be overlooked. Yet these sensory manifestations are of interest and importance, not only as an aid to accurate diagnosis, but also in view of the dubiety still existing as to the locality of the sensory cortex.

Occasionally, it is true, the impairment of cutaneous sensibility is so slight that the patient can feel and localize the gentlest touch when he cannot tell the difference between the head and point of a pin, and his appreciation of each form of sensation is less acute than on the sound side. Such slight peripheral evidence of a central sensory lesion may indeed seem scarcely worth recording, yet if accuracy is to be desired in the localization of the site of a lesion the smallest deviation from the normal revealed by physical examination of a patient should be of as much importance as any well-marked defect. A diagnosis founded on the examination of motor phenomena alone, without due consideration of any existing sensory impairment, is but half the truth, and is an omission of valuable aid to both the locality and extent of the lesion. On the other hand, an opinion based on a conscientious study of such motor and sensory phenomena as are presented by the patient may be confirmed by post-mortem examination, and so lead by the accumulation of evidence to the definite determination of the paths and destiny of the various sensory nerves.

Or—as occasionally happens in the experience of all—should the autopsy reveal a condition entirely at variance with the ante-mortem diagnosis, the fact that sensation has been definitely affected in such a case, and the degree and nature of the impairment correctly recorded, may be of no small value in the localization of the sensory pathways.



The testing of sensation is a task which necessitates the expenditure of much time and infinite patience, but such expenditure is surely fully justified when we consider its aim to be the elucidation of one of the most puzzling problems in the intricate subject of cerebral localization.













TABLE(S)  
RUN INTO  
GUTTER